

HEC-RAS Applications Guide

Table of Contents

Foreword	xii
Introduction	xii
Example 1 Critical Creek.....	1-1
Purpose	1-1
Subcritical Flow Analysis.....	1-1
Geometric Data	1-1
Flow Data.....	1-3
Steady Flow Analysis.....	1-4
Subcritical Flow Output Review.....	1-5
Mixed Flow Analysis	1-11
Modification of Existing Geometry	1-11
Flow Data.....	1-13
Mixed Flow Analysis	1-13
Review of Mixed Flow Output	1-14
Summary.....	1-16
Example 2 Beaver Creek - Single Bridge	2-1
Purpose	2-1
Pressure/Weir Flow Analysis	2-1
River System Schematic	2-2
Cross Section Geometric Data	2-3
X-Y Coordinates	2-3
Reach Lengths	2-4
Manning's n Values	2-6
Levees	2-6
Contraction/Expansion Coefficients	2-7
Bridge Geometry Data	2-8
Bridge Deck and Roadway Geometry	2-8
Bridge Pier Geometry	2-10
Ineffective Flow Areas.....	2-13
Bridge Modeling Approach	2-14
Low Flow Methods.....	2-14
High Flow Methods	2-16
Steady Flow Data	2-17
Pressure/Weir Flow Simulation	2-19
Review of Pressure/Weir Flow Output	2-20
First and Second Flow Profiles.....	2-21
Third Flow Profile	2-22
Energy Method Analysis	2-22
Energy Method Data and Simulation.....	2-22
Review of Energy Method Output	2-23

Evaluation of Cross Section Locations.....	2-23
Expansion Reach Length	2-23
Contraction Reach Length	2-26
Expansion Coefficient.....	2-27
Contraction Coefficient.....	2-28
Model Calibration.....	2-29
Comparison of Energy and Pressure/Weir Flow Methods to Observed Data	2-31
Summary	2-33
 Example 3 Single Culvert (Multiple Identical Barrels).....	3-1
Purpose	3-1
Geometric Data.....	3-1
River System Schematic	3-2
Cross Section Geometry.....	3-3
Cross Section Placement.....	3-4
First Cross Section	3-6
Second Cross Section	3-8
Third Cross Section	3-8
Fourth Cross Section.....	3-8
Culvert Data	3-9
Deck/Roadway Data	3-9
Culvert Geometric Data	3-11
Steady Flow Data	3-16
Flow Data.....	3-16
Boundary Conditions	3-16
Steady Flow Analysis	3-18
Output Analysis	3-19
Expansion and Contraction Reach Length Evaluations	3-19
Expansion Reach Length	3-19
Contraction Reach Length	3-20
Channel Contraction and Expansion Coefficients	3-21
Expansion Coefficient.....	3-21
Contraction Coefficient.....	3-22
Water Surface Profiles	3-22
Summary	3-28
 Example 4 Multiple Culverts.....	4-1
Purpose	4-1
Geometric Data.....	4-1
River System Schematic	4-2
Cross Section Geometry.....	4-2
Expansion and Contraction Reach Lengths	4-3
Culvert Data	4-3
Deck/Roadway Data	4-3
Culvert Geometric Data	4-3
Ineffective Flow Areas.....	4-8
Steady Flow Data	4-9
Steady Flow Analysis	4-9

Output Analysis	4-9
Expansion and Contraction Reach Lengths	4-10
Expansion Reach Length	4-10
Contraction Reach Length	4-11
Channel Contraction and Expansion Coefficients	4-12
Expansion Coefficient.....	4-12
Contraction Coefficient.....	4-12
Water Surface Profiles	4-13
Summary...	4-16
Example 5 Multiple Openings	5-1
Purpose	5-1
River System Geometric Data	5-2
River System Schematic	5-2
Cross Section Geometry.....	5-3
Placement of the Cross Sections	5-3
Bridge Geometry	5-3
Deck/Roadway Data	5-3
Piers and Abutments	5-5
Bridge Modeling Approach	5-5
Culvert Geometry	5-6
Multiple Openings	5-7
Stagnation Limits	5-8
Ineffective Flow Areas.....	5-10
Manning's n Values.....	5-11
Cross Section Locations	5-11
Expansion Reach Length	5-11
Contraction Reach Length	5-13
Coefficients of Expansion and Contraction	5-13
Steady Flow Analysis	5-14
Multiple Opening Output Analysis.....	5-15
Cross Section Placement Evaluation.....	5-15
Water Surface Profiles	5-15
Multiple Opening Profile Table	5-16
Summary...	5-20
Example 6 Floodway Determination.....	6-1
Purpose	6-1
Floodplain Encroachment Analysis Procedure.....	6-2
Base Flood Profile	6-4
Method 5 Optimization Procedure	6-4
Method 5 Steady Flow Data.....	6-4
Method 5 Encroachment Data.....	6-5
Method 5 Output Review.....	6-7
Method 4 Encroachment Analysis - Trial 1.....	6-8
Method 4 Steady Flow Data - Trial 1	6-9
Method 4 Encroachment Data - Trial 1	6-10
Method 4 Output - Trial 1	6-11
Method 4 Encroachment Analysis - Trial 2.....	6-13

Method 4 Steady Flow Data - Trial 2	6-13
Method 4 Encroachment Data - Trial 2	6-14
Method 4 Output - Trial 2	6-15
Method 4 Encroachment Analysis - Trial 3.....	6-18
Method 1 Encroachment Analysis.....	6-19
Method 1 Steady Flow Data.....	6-19
Method 1 Encroachment Data.....	6-20
Method 1 Output.....	6-20
Summary...	6-21
 Example 7 Multiple Plans	7-1
Purpose	7-1
Elements of a Project.....	7-1
Elements of a Plan	7-2
Existing Conditions Analysis	7-3
Existing Conditions Geometry.....	7-3
Steady Flow Data	7-5
Existing Conditions Plan.....	7-6
Existing Conditions Output.....	7-7
Proposed Conditions Analysis.....	7-8
Proposed Conditions Geometric Data.....	7-8
Steady Flow Data	7-9
Proposed Conditions Plan	7-9
Proposed Conditions Output	7-10
Comparison of Existing and Proposed Plans.....	7-10
Profile Plot	7-10
Cross Section Plots.....	7-12
Standard Table	7-13
Bridge Only Table.....	7-14
X-Y-Z Perspective Plot.....	7-15
Summary...	7-16
 Example 8 Looped Network	8-1
Purpose	8-1
Geometric Data.....	8-1
River System Schematic	8-1
Cross Section Data	8-2
Stream Junction Data	8-3
Steady Flow Data	8-4
Profile Data	8-4
Boundary Conditions	8-5
Steady Flow Analysis	8-6
Analysis of Results for Initial Flow Distribution	8-7
Steady Flow Analysis with New Flow Distribution	8-8
Analysis of Results for Final Flow Distribution.....	8-9
Summary...	8-9
 Example 9 Mixed Flow Analysis	9-1
Purpose	9-1

Geometric Data.....	9-1
River System Schematic	9-1
Cross Section Data	9-2
Location of the Cross Sections.....	9-2
Bridge Data	9-4
Deck/Roadway Data	9-4
Pier Data	9-5
Bridge Modeling Approach	9-6
Steady Flow Data	9-7
Profile Data	9-7
Boundary Conditions	9-8
Steady Flow Analysis.....	9-9
Review of Output for Energy Analysis	9-10
Water Surface Profile.....	9-10
Water Surface Profiles for Subcritical and Supercritical Flow Analyses.....	9-13
Profile Table - Bridge Comparison.....	9-15
Cross Section Table - Bridge	9-15
Pressure/Weir Analysis.....	9-17
Review of Output for Pressure/Weir Analysis	9-19
Water Surface Profile.....	9-19
Expansion and Contraction Reach Lengths	9-20
Expansion Reach Length	9-20
Contraction Reach Length	9-20
Bridge Comparison Table	9-21
Bridge Detailed Output Table	9-22
X-Y-Z Perspective Plot.....	9-23
Summary.....	9-24
 Example 10 Stream Junction	10-1
Purpose	10-1
Geometric Data.....	10-1
River System Schematic	10-1
Cross Section Placement.....	10-3
Cross Section Data	10-4
Stream Junction Data - Energy Method	10-5
Steady Flow Data	10-6
Steady Flow Analysis (Stream Junction Energy Method).....	10-8
Review of Output for Stream Junction Energy Analysis.....	10-9
Water Surface Profile.....	10-9
Standard Table 2	10-10
Steady Flow Analysis (Stream Junction Momentum Method).....	10-11
Review of Output for Stream Junction Momentum Analysis.....	10-13
Water Surface Profile.....	10-13
Standard Table 2	10-14
Comparison of Energy and Momentum Results.....	10-15
Summary.....	10-17
 Example 11 Bridge Scour	11-1

Purpose	11-1
Geometric Data.....	11-2
Steady Flow Data	11-3
Steady Flow Analysis.....	11-4
Hydraulic Design - Bridge Scour	11-5
Contraction Scour	11-6
Pier Scour	11-8
Abutment Scour	11-9
Total Bridge Scour	11-10
Summary...	11-12
 Example 12 Inline Weir and Gated Spillway	12-1
Purpose	12-1
Geometric Data.....	12-1
Cross Section Data	12-2
Inline Weir	12-2
Gated Spillway	12-5
Ineffective Flow Areas.....	12-7
Cross Section Placement.....	12-8
Steady Flow Data	12-9
Flow Profiles	12-9
Boundary Conditions	12-10
Gate Openings.....	12-11
Steady Flow Analysis	12-13
Output Analysis	12-13
Water Surface Profiles	12-13
Inline Weir Detailed Output Table.....	12-14
Inline Weir Profile Summary Table.....	12-17
Summary...	12-18
 Example 13 Bogue Chitto - Single Bridge (WSPRO)	13-1
Purpose	13-1
Geometric Data.....	13-2
River System Schematic	13-2
Cross Section Geometric Data	13-3
Cross Section Placement	13-4
Bridge Geometry Data	13-7
Bridge Deck and Roadway Geometry	13-7
Bridge Pier Geometry	13-9
Sloping Abutments	13-10
Ineffective Flow Areas.....	13-11
Bridge Modeling Approach	13-14
Low Flow Methods.....	13-14
High Flow Methods	13-17
Steady Flow Data	13-18
Steady Flow Analysis	13-20
Review of Output	13-21
Water Surface Profiles	13-21
Profile Tables	13-23

Detailed Output Tables	13-26
Evaluation of Cross Section Locations.....	13-26
Expansion Reach Length	13-27
Contraction Reach Length	13-28
Expansion and Contraction Coefficients.....	13-29
Summary	13-29
Example 14 Ice-Covered River.....	14-1
Purpose	14-1
Open Water Analysis.....	14-2
Open Water Geometry	14-2
Steady Flow Data	14-2
Open Water Plan.....	14-3
Open Water Output.....	14-3
Ice Cover Analysis	14-3
Ice Cover Geometry	14-3
Steady Flow Data	14-4
Ice Cover Plan.....	14-4
Ice Cover Output.....	14-4
Ice Jam Analysis.....	14-5
Ice Jam Geometry	14-5
Steady Flow Data	14-6
Ice Jam Plan	14-6
Ice Jam Output	14-6
Comparison of Open Water, Ice Cover, and Ice Jam Results.....	14-7
Profile Plot	14-7
Ice Table.....	14-9
Example 15 Split Flow Junction With Lateral Weir/Spillway	15-1
Purpose	15-1
Geometric Data.....	15-1
Stream Junction Data	15-2
Cross Section Data	15-3
Lateral Weir	15-4
Gated Spillway.....	15-6
Steady Flow Data	15-8
Flow Profiles	15-8
Boundary Conditions	15-9
Gate Openings.....	15-10
Steady Flow Analysis	15-11
Output Analysis	15-13
Water Surface Profiles	15-13
Lateral Weir Detailed Output Table.....	15-14
Lateral Weir Profile Summary Table.....	15-15
Junction Profile Summary Table.....	15-16
Standard Profile Summary Table	15-17
Additional Adjustments.....	15-18
Junction Flow Splits.....	15-18
Lateral Weir Splits	15-18

Summary	15-19
Example 16 Channel Modification..... 16-1	
Purpose	16-1
Geometric Data.....	16-1
Channel Modification Data	16-1
Performing The Channel Modifications.....	16-4
Saving The Channel Modifications.....	16-4
Steady Flow Analysis	16-5
Comparing Existing and Modified Conditions.....	16-5
Steady Flow Analysis.....	16-5
Water Surface Profiles	16-6
Cross Section Plots.....	16-7
X-Y-Z Perspective Plot.....	16-8
Standard Table	16-9
Summary	16-10
Example 17 Unsteady Flow Application..... 17-1	
Purpose	17-1
Geometric Data.....	17-1
General Description	17-1
Creating Storage Areas	17-3
Entering Data for a Storage Area.....	17-5
Lateral Weir Connected to a Storage Area	17-6
Hydraulic Connections.....	17-8
Parameters for Hydraulic Tables.....	17-9
Cross Section Table Parameters.....	17-10
Unsteady Flow Data	17-11
Boundary Conditions	17-11
Upstream Boundary Condition	17-12
Downstream Boundary Condition	17-14
Initial Conditions	17-14
Unsteady Flow Analysis.....	17-16
Simulation Time Window	17-16
Computation Settings.....	17-17
Location of Stage and Flow Hydrographs	17-17
Unsteady Flow Simulation	17-18
Geometric Pre-Processor (HTAB)	17-18
Unsteady Flow Simulation and Post-Processor	17-20
Summary	17-24